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This invention relates to a floor system comprising rigid floor panels of uniform size supported in abutting relation upon metal stringers spaced above a sub-floor surface by pedestals, the floor panels being formed from a pair of metal sheets of the same area and spaced vertically except at the edges which have flanges welded together in overlying relation, the flanges being received in yieldable channels of insulation material, and current conducting means extending around a flange of at least one of said channels to commonly engage the metal flange of the floor panel and a metal stringer which supports said flange to ground the same.

The advent of complex electronic equipment, such as data processing machines, computers, and the like, has necessitated the use of substantial amounts of electrical conduits and cables for which provision must be made so that the same might extend between various pieces of equipment as well as to sources of power and the like. One very convenient means for accommodating such cable comprises the arrangement of a supporting floor system disposed a limited distance above a sub-floor, whereby the space between the two floors readily may accommodate very substantial quantities of cables of various sizes and at the same time provide a clear floor supporting surface upon which the equipment is mounted without the danger of tripping over conduits which otherwise might be disposed above the said upper floor surface.

Various types of elevated floor structures have been devised heretofore, many of these utilizing extruded aluminum panels having various degrees of complexity and equally complex and sophisticated supporting means therefor in order to prevent any flexing of the panels when heavy equipment is placed thereon for support. Panels and supporting structure of this type are quite expensive. As a result, there has been constant effort exerted to provide more simple and less expensive elevated floor

structures without depreciating the strength thereof, the simplification not only extending to the elements of the floor system per se, but similarly simplifying and therefore decreasing the cost of installing the same.

The present floor panel and system are improvements over a previous system, the panels employed in the same comprising the subject matter of Canadian patent application Serial No. 952,509, filed February 17, 1966, the same being owned by the present applicant.

It is the principal object of the present invention to provide a further improved elevated floor system and floor panel per se for use with said system, as compared with said system and floor panel referred to immediately above, such improvement primarily residing in still further simplification over the foregoing with respect to structure and installation costs, all without depreciating strength.

A still further object of the present invention is to provide in said improved floor system resilient cushioning and sealing means between the peripheral edges of the floor panel and the supporting stringers therefor so as to minimize the transmission of vibration and sound from one section of said flooring to another, for example, said cushioning and shielding means also being of an electrical insulating nature.

Still another object of the invention, ancillary to the immediately foregoing object, is to provide simple but highly effective electrical grounding means between said floor panels and metallic stringers which support the same so as to assure the transmission of stray currents to ground. A further object of the invention is to provide improved simplified and less expensive positioning means between the caps on pedestals of the elevated flooring system and stringers supported by said caps, as well as also providing highly effective and interrelated

positioning means between said stringers and the floor panels which are received within the openings or spaces between a grid-like arrangement of said stringers.

A still further object of the invention is to provide resilient cushioning and sealing means of channel shape which extend along all of the edges of the floor panel which, preferably, are straight and arranged at right angles to each other, the terminal edges of said floor panels also including improved design; whereby a reinforced, composite and horizontal supporting flange extends around the entire perimeter of the floor panels within the plane of the upper surface thereof, the outermost edge portions of said flanges being accommodated within the channel of said chennel-like cushioning and sealing means, whereby the latter arrangement not only serves to support the floor panels upon stringers in a cushioned and sealed manner but the upper flange of said channel-shaped sealing means also provides a finishing strip for wear-surface covering means, such as sheet or tile-type panels of which linoleum, and asphalt or plastic tiles are examples.

Details of the foregoing objects as well as details of the invention, and other objects thereof, are set forth in the following specification and illustrated in the accompanying drawings comprising a part thereof.

In the drawings:

Fig. 1 is an exemplary, fragmentary and perspective view of an exemplary elevated floor system embodying the principles of the present invention, certain of the floor panels of said system being removed to illustrate details of the supporting means therefor.

Fig. 2 is a fragmentary vertical sectional view on a larger scale than in Fig. 1, and showing a part of a floor panel, including details of the structure thereof as well as the manner

of supporting such panel by stringer and pedestal means.

Fig. 3 is a fragmentary bottom plan view of one corner of a floor panel of the type illustrated in Fig. 2 and embodying the principles of the invention.

Fig. 4 is a fragmentary, enlarged plan view of one of the pedestals of the system shown in Fig. 1 to which fragmentary portions of four stringers are connected by clamping means comprising part of the present invention and also showing positioning means between said stringers and cap of said pedestal.

Fig. 5 is a fragmentary perspective view of the structure shown in Fig. 4, particularly to further illustrate details of the coengaging positioning means between the cap of the pedestal and the stringers.

Fig. 6 is a fragmentary vertical sectional view showing details of the coengagement of abutting edge portions of two floor panels in relation to a stringer.

Fig. 7 is a fragmentary vertical section, on a still larger scale than used in Fig. 6, illustrating details of electrical grounding means extending between the edge of one of said panels and a supporting stringer.

Referring to the drawings, the general arrangment of elevated floor structure shown in exemplary manner in Fig. 1 comprises a plurality of floor panels 10 which, essentially, are formed from sheet metal of appropriate gauge. As will be best seen from Figs. 2 and 3, the metallic portion of such panels comprise a flat, uninterrupted upper load-receiving panel 12. All of the edges of said panel, according to preferred construction, are straight and are disposed at right angles to each other, whereby said upper panel may be either square or rectangular.

The lower panel 14 is referred to as the tension-sustaining panel and, as will be seen from Fig. 2, it is parallel to and spaced a predetermined distance throughout its area below the

upper panel 12. Further in the preferred construction, the upper panel 12 is formed from sheet metal which is slightly thicker than the sheet metal from which the lower panel 14 is formed, primarily because the upper panel 12, in addition to comprising the load-receiving or sustaining panel, also is subjected to compression when supporting a load, as will be described in greater detail hereinafter.

Referring to Fig. 3, it will be seen that the lower panel 14 is provided preferably throughout its entire area with an evenly spaced pattern of recesses or openings 16 which are preferably either square or rectangular to provide between said recesses a crisscross series of two sets of parallel, substantially straight strips 18 and 20 that are transverse to each other and which sustain tension as a result of loads disposed upon the upper panel 12, the load imposed upon said upper panel being transmitted to the tension-sustaining strips 18 and 20 of the lower panel 14 by means of the metal which is removed or displaced from the plane of the lower panel 14 to form said recesses or openings.

Said displaced metal is shaped or arranged into strut-like members 22 which are connected to the lower panel 14, for example, along opposite sides of each of the recesses or openings 16 and then are bent substantially perpendicularly to the lower panel, the terminal ends 24 of said strut-like members 22 being bent perpendicularly thereto, as best seen in Fig. 2, so as to underlie the lower surface of upper panel 12, said ends 24 being welded to said upper panel 12 appropriately as indicated symbolically in Fig. 3. Thus, the strut-like members 22 not only transmit the load of upper panel 12 to the straight tension strips 18 and 20 of lower panel 14, but the angular arrangement of the strut-like members 22 and also the bent terminal ends 24 thereof supply rigidity to the upper panel 12.

The peripheral marginal portions 26 extending along the outer edge portions of the lower panel 14 are bent transversely thereto and extend upwardly into contact with the undersurface of the upper panel 12, as can best be seen from Fig. 2. These portions are uninterrupted from end to end and thereby supply a substantial amount of bracing and rigidity to the assembled panels. Further, the terminal edge portions 28 of the marginal portions 26 are bent laterally outwardly therefrom so as to be parallel to and abuttingly underlie the lower surface of upper panel 12, to permit welding of said terminal edge portions to the peripheral edge portions of the upper panel 12, such as by spot welding connections arranged at appropriate intervals.

This arrangement provides several advantages, one being that of strength by affording a composite horizontal supporting flange of double thickness of metal sheets surrounding the entire periphery of the floor panel 10. Secondly, by precisely shearing the edge with appropriate dies, the terminal edge of such supporting flanges can be made very precise for purposes to be described.

From the foregoing, it will be seen that the panel 10 is composed of two panels, respectively designated as an upper panel and a lower panel, and strut-like means displaced from the lower panel extend upwardly into engagement with the upper panel and are securely fastened thereto such as by spot welding, thereby minimizing the cost of production and expediting fabrication thereof. It is also possible to form the displaced strut-like members 22 such as by initially piercing a flat sheet of material with a plurality of narrowslots, successive slots in several directions in the pattern respectively being transverse to each other and there being only a single slot required to form each recess or opening 16.

The forming die preferably is arranged to sever the sides of the tongues or ears which become the members 22 from the sheet

which becomes the bottom panel 14 while incidentally shaping the strut-like members 22 and bending the terminal ends 24 thereof into suitable shape. The same dies which form the strut-like members 22 also can be utilized simultaneously to shape and form the peripheral marginal portions 26 and the terminal edge portions 28 thereof, whereby the bottom panel 14 thus is completely shaped and is in readiness to be attached quickly and effectively to the upper panel 12, such as by spot welding, thereby completing the fabrication of the metal portion of the floor panel 10. Following the final shearing of the terminal edges of the composite, double thickness supporting flanges 30 so as to render the same precisely straight as well as at a precise right angle to the adjacent flanges 30 along the other edges of the floor panel 10, the panel 10 is ready for finishing operations, as follows.

Especially for purposes of minimizing the transmission of sound and vibration imposed upon any particular floor panel or panels by the equipment supported thereon through contact with adjacent panels included in the entire floor, the present invention provides means to minimize direct transmission of sound and vibration between adjacent panels by utilizing combination finishing and supporting strips 32 which are channel-shaped, as can be best seen from Fig. 7. The material from which these are formed with precise dimensions preferably is a selected, suitable synthetic resin or plastic material having limited resilience, coupled with sufficient toughness and stability of shape to enable the same to serve as a finishing strip for purposes now to be described. Unplasticized, polyvinyl chloride is one such suitable resin.

Referring especially to Fig. 7 for the best illustration of details of the channel-shaped strips 32, it will be seen that the same comprise a lower flange 34 which underlies the composite supporting flanges 30 of floor panel 10 and, when such floor

panels are employed with supporting stringers, said lower flange is adapted to rest upon the upper surface of a stringer 36, details of which are described hereinafter and certain forms of which comprise part of the present invention. It is to be understood, however, that the floor panels 10 are sufficiently strong at the corners thereof that they may be supported solely by pedestals which engage only the corners of the panels 10, if desired. The dimension of the peripheral marginal portions 26 of the floor panels 10 are such, with respect to the relative arrangement thereof with the side walls 38 of the stringer 36, that they are at least slightly spaced therefrom sufficiently that there is no metal-to-metal contact between any part of the floor panels 10 and the stringers 36, as far as the supporting function and the ability to transmit sound and vibration are concerned, such as direct metal-to-metal contact would permit.

The channel-shaped strips 32 also include an upper flange 40 which is parallel to the lower flange 34 thereof and the space between the flanges 34 and 40 is so dimensioned as to snugly receive the precisely sheared and uniformly thick composite supporting flange 30 along each side of the floor panel 10. Cement may be employed, if desired, to effect the final affixing of the strips 32 to the composite flanges 30. In addition to the cushioning support afforded by the lower flange 34 of the strips 32, the upper flange 40 thereof comprises a finishing strip surrounding and outlining the wear-surface covering layer 42 which may comprise either a unitary sheet of linoleum of a checkerboard arrangement of suitable floor tile, such as either asphalt or plastics, as desired. The thickness of the flange 40 preferably is identical with that of the covering layer 42, regardless of the nature of said layer. The layer also is secured to the upper surface of upper panel 12 by appropriate cement which may be evenly applied to said upper surface prior to disposing

the covering layer 42 thereon as well as prior to attaching the channel-shaped strips 32 thereto.

Inasmuch as a large percentage of modern electrical apparatus, especially apparatus consuming substantial quantities of power, requires the provision of grounding means in relation to conduits supplying power to the equipment, and also in view of the fact that the space below the assembly of floor panels 10 of the present invention, which comprise a supporting floor for the equipment above a space in which the conduits are disposed, actually comprises a conduit, the present invention provides a highly effective and simple means for effecting grounding of the floor panels 10 with respect to the supporting stringers 36, details of which are best shown in Fig. 7 and a description of which will now be given.

In the preferred construction of the floor panels 10 which has proven highly practical and satisfactory from a use standpoint, the panels are approximately 24" square. The exemplary vertical dimension of the peripheral marginal portions 26 thereof is within the range of slightly in excess of 1". Further, the vertical dimension of the channel-shaped strips 32 is of the order of slightly in excess of 1/4" and the lower flange 34 thereof is of the order of approximately 1/16" in vertical thickness. In regard to the foregoing, however, the specific references to dimensions and nature of material are to be considered as exemplary only, rather than restrictive, since departures therefrom may be made, at least within reasonable limits, and still be within the contemplation of the present invention.

Particularly in view of the resilient and slightly compressible nature of the plastics material from which the channel-shaped strips 32 are formed, together with the very limited vertical thickness of the lower flange 34 thereof, said structure lends itself to the inclusion of very simple yet highly

effective grounding means, the preferred structure of which comprises a U-shaped grounding element 44 formed from suitable metal foil, such as aluminum foil. Each of these elements need only be of the nature of about 1" or less in length. The width, before bending, is only slightly in excess of 1/4". One surface of the strip, before bending, is provided with a suitable cement, such as appropriate pressure-sensitive cement, whereby affixing the strip to said lower flange 34 so as to extend around a portion of the channel-shaped cushioning members 32 is accomplished very simply prior to attaching the channel-shaped cushioning members or strips 32 to the various composite supporting flanges 30 of the floor panels 10.

It actually is only necessary to affix one of the grounding elements 44 to each floor panel 10 although, for additional safety and uniformity of construction, one of such elements may be affixed to each of the channel-shaped members 32 prior to affixing the same to one of the composite flanges 30 along each side of the material from which the channel-shaped members or strips 32 are formed and the fact that the U-shaped grounding members 44 surround the lower flange 34 thereof, when the floor panel 10 is disposed in supporting relationship with respect to the stringers 36, and particularly when a load is imposed upon the floor panels 10, such load will insure firm contact of the upper and lower portions of the grounding element 44 respectively with the undersurface of the composite supporting flange 30 of the floor panel and the upper surface of the supporting stringer 36. In addition, the resilience and limited compressibility of the lower flange 34 of the channel-shaped member 32 will react against the inner surfaces of the grounding element 44 between which the flange 34 is sandwiched, thus further assuring firm metallic contact between the grounded stringers 36 and the metal portions of the floor panel 10 supported by said stringers.

The present invention also comprises an elevated floor system embodying a plurality of the floor panels 10, described above, arranged in edge-abutting and sealing relationship with respect to each other, within a common plane, and supported in spaced relationship above a sub-flooring by means of a grid-like arrangement of metallic stringers 36 supported at the juncture point of said stringers by a pedestal 46. With reference to Fig. 1, a plurality of such pedestals are illustrated, the same comprising vertically adjustable, telescoping members, details of which are best shown in Fig. 2 and wherein an upper sleeve portion 48 telescopically receives a threaded rod supported vertically by a foot piece 52 rigidly secured to the lower end of threaded rod 50, such as by welding. An adjusting nut 54 is threaded upon the rod 50 and abuts the lower end of the sleeve portion 48 of the pedestal to secure the same in desired vertical adjustment. An appropriate bail-type lock 56 prevents rotation of nut 54.

Secured fixedly to the upper end of sleeve portion 48 is a flat, plate-like cap 58 of suitable gauge steel, the same being welded, for example, to the upper end of sleeve portion 48. As best seen from Figs. 1, 4 and 5, the cap 58 preferably is square and the corners thereof have portions slit therefrom and bent perpendicularly upward from the plane of the cap to provide positioning lugs 60, details of which are best shown in Fig. 5.

The stringers 36 preferably are tubular, as can be readily seen from Fig. 6, the preferred cross-sectional shape thereof being rectangular and, in addition, the sides 38 preferably are greater in height than the width of the stringer 36 in use, thereby affording very effective resistance to flexing, which supplements the inherent ability of the structure of floor panels 10 to resist flexing when sustaining load, thereby producing a composite structure highly capable of sustaining relatively great concentrated loads with only imperceptible flexing from the nor-

mal flat plane of said panels.

Located, for example, within several inches from the end of each stringer 36, the lower wall thereof is provided with a positioning hole 62 having a diameter only very slightly greater than the widest dimension of the positioning lug 60 for purposes of readily receiving such positioning lug, thereby serving to accurately space and position the pedestals 46 and facilitate the installation of the supporting structure for the floor panels.

Further to maintain the stringers 36 in detachably locked relationship with respect to the caps 58, the invention also includes cross-shaped clamping members 64 provided with a central aperture to receive a locking bolt 66 which is threadably received within a tapped hole in the center of cap 58, for example. As can be seen especially from Fig. 4, wherein the clamping member 64 is shown in plan view, a substantial portion of each of the projecting arms 68 is received within the open ends of each of the stringers 36 supported by cap 58, such arms bearing against the bottom wall of each stringer and thus clamping the same against the upper surface of the cap 58. As also will be seen from Fig. 4, the preferably square cap 58 is arranged diagonally with respect to the stringers 36, whereby the corners of the cap 58 are disposed beneath the ends of the stringers and thus utilize the maximum supporting effect of a minimum requirement of total area of the caps 58.

As has been indicated above, the length of the stringers 36 is selected with respect to the transverse dimensions of the floor panels 10 so that, when the grid-like arrangement of stringers, as shown in exemplary manner in Fig. 1, has been mounted in operative position upon a sub-floor 70, after leveling the stringers to dispose the upper surfaces thereof preferably within a common flat plane, the recesses or spaces outlined by a square pattern of four of the stringers 36, will readily and rather closely receive the

depending lower portion of each of the floor panels 10 within said recess or space 72 but nevertheless will provide a limited clearance space 74 between each of the side walls 38 of the stringers 36 and all the vertical peripheral marginal portions 26 of the floor panels 10, as best shown in Fig. 6. Thus, in conjunction with the cushioning effect afforded by the lower flanges of the channel-shaped finishing and supporting strips 32, they also function to prevent any direct metal-to-metal contact between the floor panels per se and the supporting structure therefor with the exception of the very small and limited amount of grounding contact afforded by the metallic elements 44. While sufficient in size to afford desired grounding, the elements 44, particularly due to the preferably foil nature thereof and the very limited size will cause no perceptible transmission of sound or vibration between the metallic portions of the floor panels 10 and the supporting stringers 36.

When the supporting structure comprising the pedestals and stringers have been accurately positioned and clamped into operative relationship, the distance between the arrangement of the stringers 36 not only will result in the spaces 74 being provided between the vertical marginal portions 26 of the floor panels and the side walls 38 of the stringers but, in addition, the dimensions of the channel-shaped finishing and supporting strips 32 are so dimensioned that such strips on adjacent floor panels not only resiliently and tightly engage the upper surface of the stringers 36, so as to effect a seal therebetween, but they firmly and resiliently contact each other along the vertical side walls of the channel-shaped strips 32 so as to further effect sealing therebetween. Hence, substantially air-tight relationship is established between the atmosphere above an elevated floor structure embodying the principles of the present invention and the conduit space below the floor panels, for whatever purpose such

sealing relationship may be desired.

While the invention has been described and illustrated in its several preferred embodiments, it should be understood that the invention is not to be limited to the precise details herein illustrated and described since the same may be carried out in other ways falling within the scope of the invention as claimed.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A metallic floor panel capable of sustaining loads without appreciable deflection comprising in combination, a flat planar upper load-receiving metallic panel having four straight sides arranged at right angles to each other, a lower tension-sustaining metallic panel complementary in shape to said upper panel, said lower panel being spaced below the lower surface of said upper panel in use and parallel thereto and having a substantially evenly spaced pattern of recesses therein across at least the major portion of the surface thereof to form a criss-cross series of two sets of parallel substantially straight strips to sustain tension arranged transversely to each other, the metal displaced to form said recesses extending upwardly strut-like from edges of said recesses into contact with said upper panel and fixed thereto and the peripheral margins of said lower metal panel being longitudinally continuous and bent upwardly from the plane of said lower metal panel to form vertical bracing flanges extending substantially perpendicularly into contact with said upper metal panel and the terminal edge portions thereof being integral with and bent outwardly from said peripheral margins to form outermost flanges parallel to and underlying and directly engaging the lower surface of the terminal edges of said upper metal panel and the extremities thereof being evenly coextensive with each other, means fixedly securing said terminal edges of said upper metal panel to said outermost flanges of said lower metal panel to form a composite marginal supporting flange within the plane of said upper metal panel on said floor panel around substantially the entire perimeter thereof for engagement with supporting means, channel-shaped elongated cushioning and sealing members formed of material of limited yieldability extending along and coextensively

receiving the outer edge portions of said composite marginal supporting flanges of said floor panel, and wear surface means covering the upper surface of said floor panel, the upper surfaces of the upper flanges of said channel-shaped member being flush with said wear surface means and forming a finish strip for the outermost edges of said wear surface means and the lower flanges of said channel-shaped members forming cushion means adapted to be engageable with supporting members for said floor panel and operable to minimize the transmission of sound therebetween.

2. The metallic floor panel according to Claim 1 further including foil-like electrical grounding means of limited length affixed to and extending around the lower flange of said cushioning and sealing means to conduct current from the metallic portions of said floor panel to grounded metallic supporting means when said floor panel is supported and cushioned thereon.

3. The metallic floor panel according to Claim 1 further including thin metallic means extending around the exterior of at least a portion of the lower flange of said channel-shaped cushioning and sealing members and engaging in electrical contact with the supporting flange of said floor panel and engageable with a supporting stringer when positioned operatively thereupon, the resilience of the portions of said lower flange of said channel-shaped member serving to insure firm engagement of said metallic grounding means respectively with said supporting flange and stringer when said floor panel is positioned thereon.

4. An elevated floor system comprising a plurality of the floor panels according to Claim 1 arranged in edge-abutting

relationship within a common plane in combination with supporting means comprising a plurality of pedestals positioned at the junctures of the corners of said floor panels and the lower ends thereof being arranged to rest upon a sub-floor for support, a cap on the upper end of each pedestal extending transversely thereto, tubular metallic stringers substantially rectangular in cross-section extending in a grid-like pattern between said caps of said pedestals, interengaging positioning means on said caps and end portions of said stringers, said plurality of floor panels being received closely within the grid-like openings between said stringers and the lower flanges of said channel-shaped cushioning and sealing members on said supporting flanges of said floor panels directly engaging the upper surfaces of said stringers for cushioned support thereby and the width of said stringers being slightly less than the spaces between the vertical bracing flanges adjacent the edges of adjacent floor panels to receive the stringers within said spaces and thereby facilitate relative positioning of said stringers and floor panels with each other, and current conducting grounding means extending around said lower flange of at least one cushioning and sealing member on each floor panel and engaging both the metallic portion of each panel and the stringer supporting the same to permit passage of stray currents from said floor panels to ground.

5. The floor system according to Claim 4 in which said grounding means is formed from thin metal of limited length and is affixed to said lower flange of said channel-shaped means.

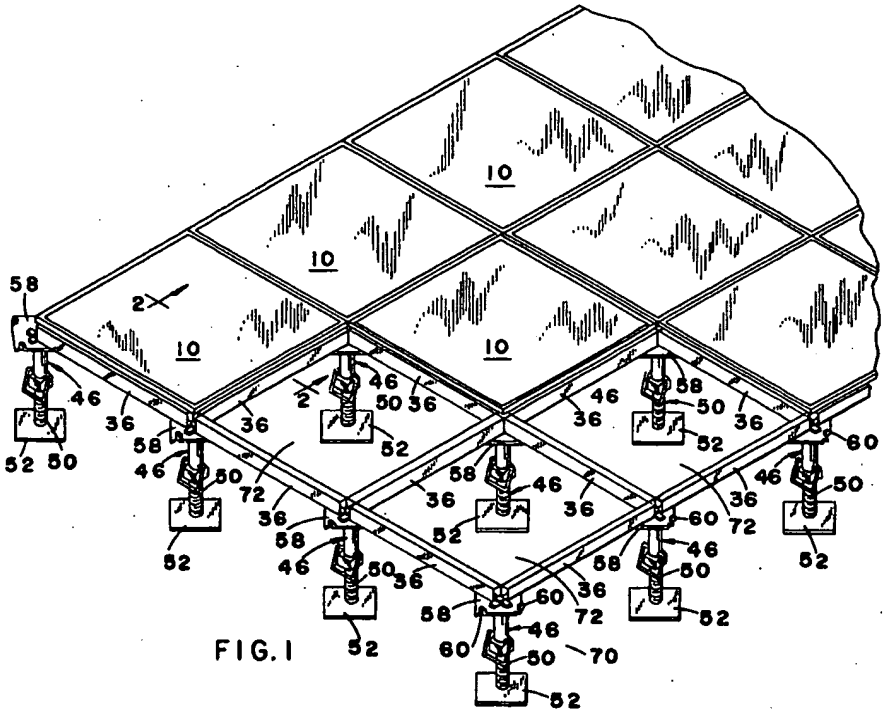

FIG. 1

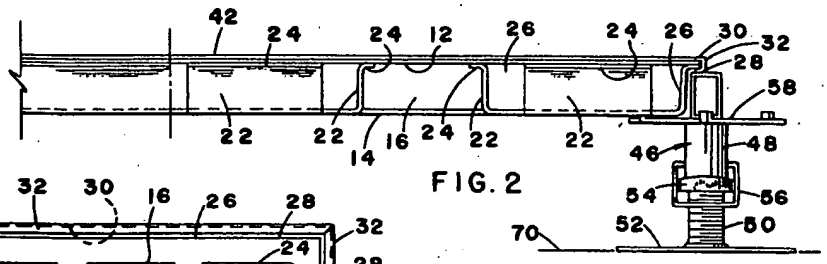

FIG. 2

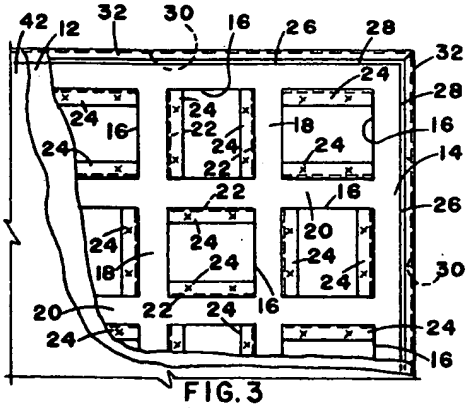

FIG. 3

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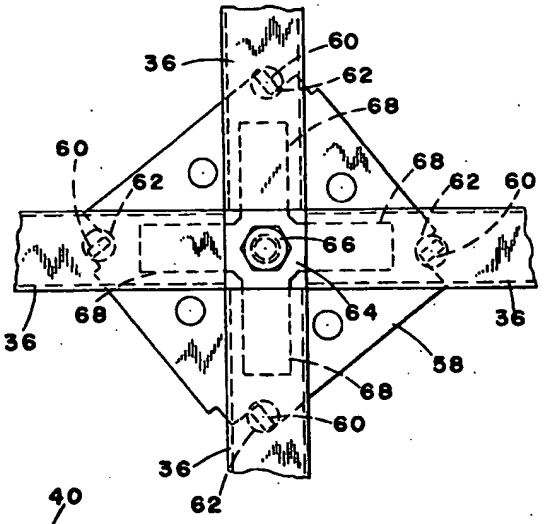

FIG. 4

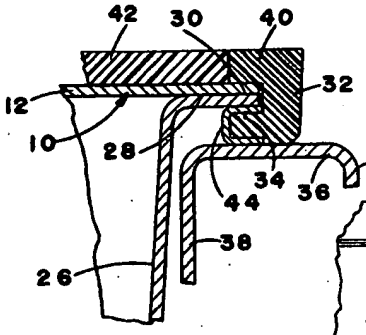

FIG. 7

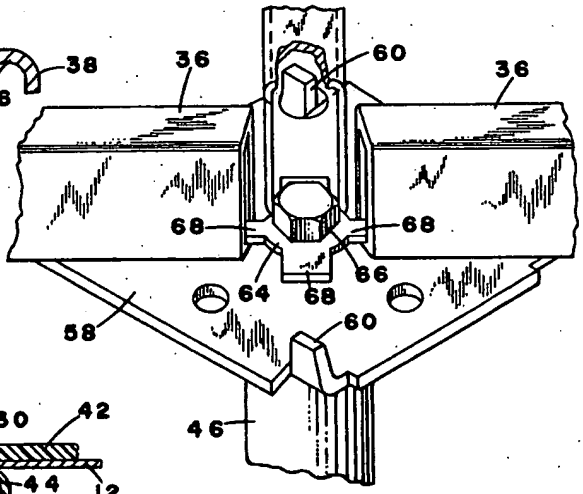

FIG. 5

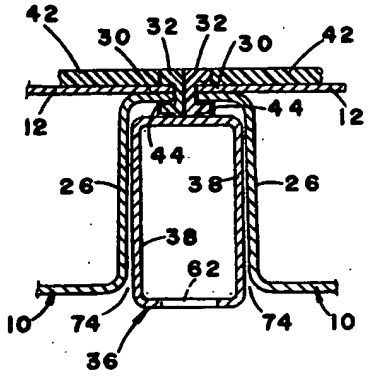

FIG. 6

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